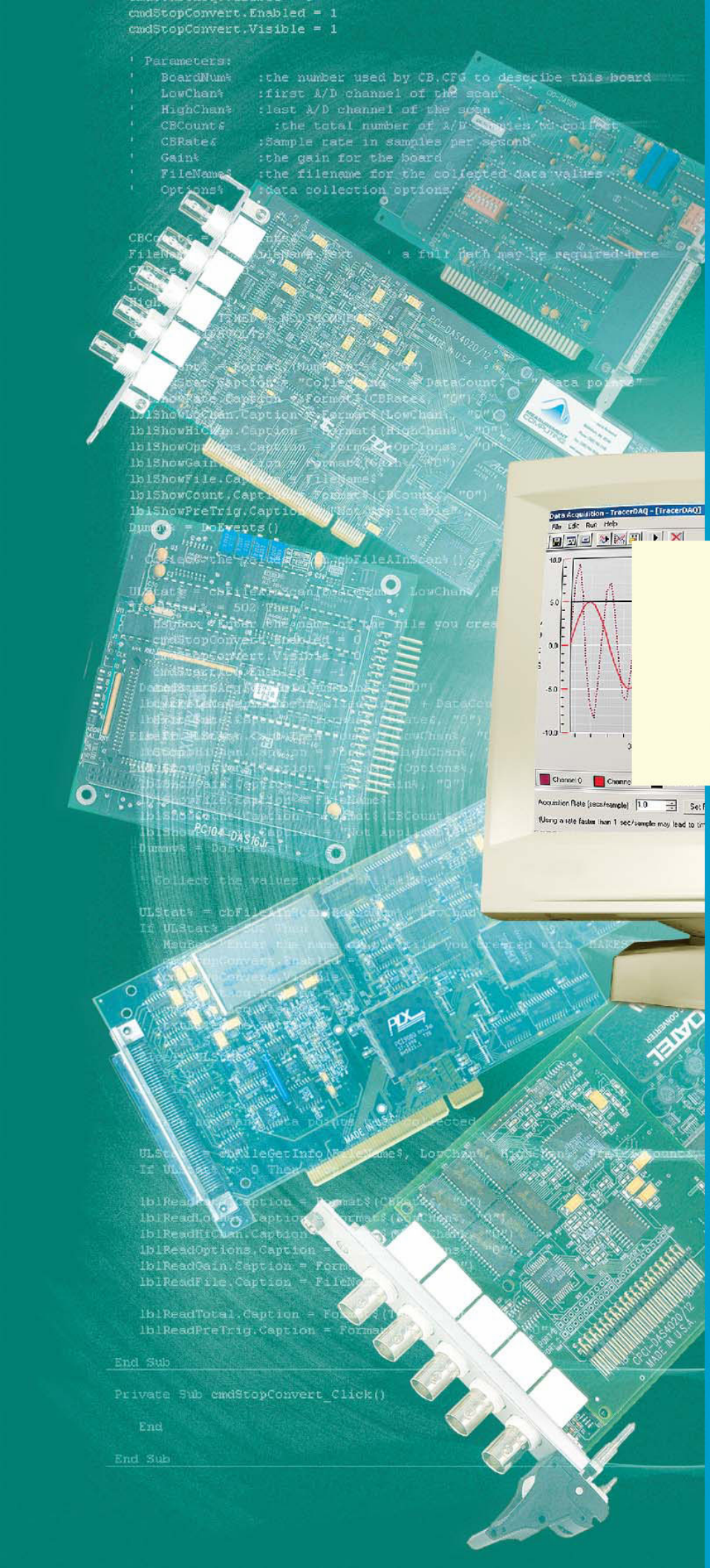


User's Guide

PCI-INT32

Interrupt/Counter Board

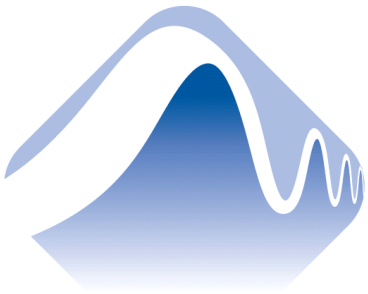
32 Vector Interrupts, 40-bits of Digital I/O, and six 16-bit Counters

MEASUREMENT COMPUTING™

PCI-INT32

Interrupt/Counter Board

User's Guide



MEASUREMENT COMPUTING™

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About this User's Guide

What you will learn from this user's guide

This user's guide explains how to install, configure, and use the PCI-INT32 so that you get the most out of the board's interrupt and counter features.

This user's guide also refers you to related documents available on our web site, and to technical support resources.

Conventions in this user's guide

For more information on …

Text presented in a box signifies additional information and helpful hints related to the subject matter you are reading.

Caution! Shaded caution statements present information to help you avoid injuring yourself and others, damaging your hardware, or losing your data.

<#:#> Angle brackets that enclose numbers separated by a colon signify a range of numbers, such as those assigned to registers, bit settings, etc.

bold text **Bold text** is used for the names of objects on the screen, such as buttons, text boxes, and check boxes. For example:

1. Insert the disk or CD and click the **OK** button.

italic text *Italic* text is used for the names of manuals and help topic titles, and to emphasize a word or phrase. For example:

- The *Insta*Cal® installation procedure is explained in the *DAQ Software Quick Start*.
- *Never* touch the exposed pins or circuit connections on the board.

Where to find more information

The following electronic documents provide helpful information relevant to the operation of the PCI-INT32.

- MCC's *Specifications: PCI-INT32* (the PDF version of Chapter 5 in this guide) is available on our web site at www.mccdaq.com/pdfs/pci-int32.pdf.
- MCC's *Register Map for the PCI-INT32* is available on our web site at www.mccdaq.com/registermaps/RegMapPCI-INT32.pdf.
- MCC's *DAQ Software Quick Start* is available on our web site at www.mccdaq.com/PDFmanuals/DAQ-Software-Quick-Start.pdf.
- MCC's *Guide to Signal Connections* is available on our web site at www.mccdaq.com/signals/signals.pdf.
- MCC's *Universal Library User's Guide* is available on our web site at www.mccdaq.com/PDFmanuals/sm-ul-user-guide.pdf.
- MCC's *Universal Library Function Reference* is available on our web site at www.mccdaq.com/PDFmanuals/sm-ul-functions.pdf.
- MCC's *Universal Library for LabVIEW™ User's Guide* is available on our web site at www.mccdaq.com/PDFmanuals/SM-UL-LabVIEW.pdf.
- The ZILOG *Z8036/Z8536 Product Specification* is available on our web site at www.mccdaq.com/PDFmanuals/Z8536.pdf.

This user's manual is also available on our web site at www.mccdaq.com/PDFmanuals/PCI-INT32.pdf.

Introducing the PCI-INT32

The PCI-INT32 is intended to be used in conjunction with the ZILOG *Z8036/Z8536 Product Specification*. This document is available on our web site at www.mccdaq.com/PDFmanuals/Z8536.pdf.

The PCI-INT32 can accept up to 32 vector interrupts and output an interrupt to the PC. The board has a pair of Z8536 I/O chips interfaced to the PCI bus. Each Z8536 accepts up to 16 independent inputs that can be used to generate interrupts from bit patterns or individual bit states or transitions. The interrupt outputs from two X8536 chips can be ANDed using software.

Many other functions can be performed by the PCI-INT32 including digital pattern recognition, counting with six 16-bit counters, and up to 40 bits of digital I/O.

The 16-bit counters can be set up independently or chained together in groups of three.

The I/O pins of the Z8536 are TTL levels. All I/O lines are accessible through a 50-pin header connector. Connections to the board typically use the C50FF-# cable and the CIO-MINI50 terminal board.

Software features

The following software ships with the PCI-INT32 free of charge.

- *Insta*Cal installation, calibration, and test utility
- TracerDAQ™ suite of virtual instruments+
- SoftWIRE® for Visual Studio® .NET graphical programming
- MCC DAQ Components for VS .NET (installed with SoftWIRE® for VS .NET)

For information on the features of *InstaCal*, TracerDAQ, and SoftWIRE, refer to the *DAQ Software Quick Start* booklet that shipped with the PCI-INT32.

PCI-INT32 functions are illustrated in the block diagram shown here.

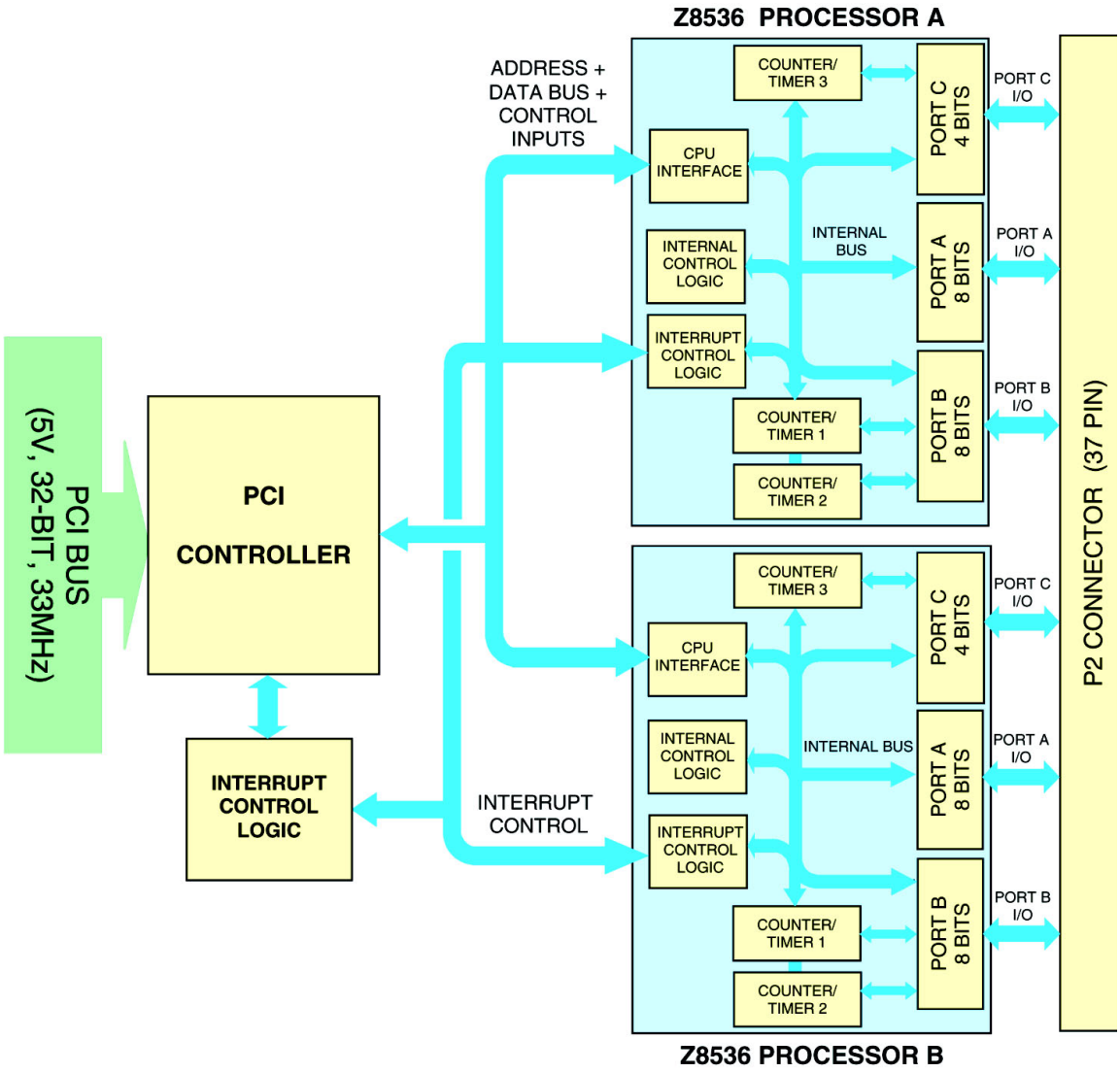


Figure 1-1. PCI-INT32 functional block diagram

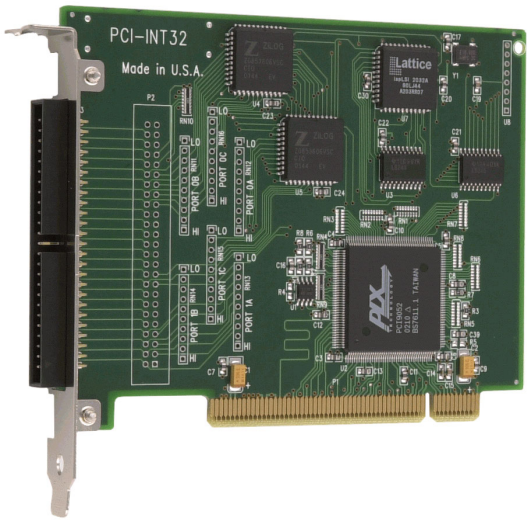
Installing the PCI-INT32

What comes with your PCI-INT32 shipment?

As you unpack your board, make sure that the following components are included.

Hardware

- PCI-INT32



Software

The *Measurement Computing Data Acquisition Software* CD contains the following software:

- *Insta*Cal installation, calibration, and test utility
- TracerDAQ suite of virtual instruments
- SoftWIRE for VS .NET
- SoftWIRE MCC DAQ Components for .NET (installed with SoftWIRE for VS .NET)

Documentation

In addition to this hardware user's guide, you should also receive the *DAQ Software Quick Start* (available in PDF at www.mccdaq.com/PDFmanuals/DAQ-Software-Quick-Start.pdf). Please read this booklet completely before installing any software and hardware.

Optional components

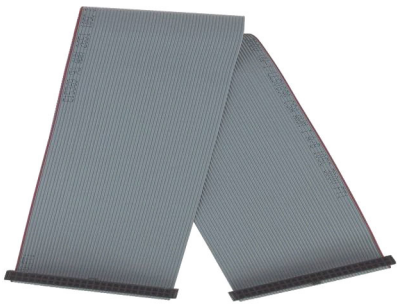
If you ordered any of the following products with your board, they should be included with your shipment.

Universal Library

- Universal Library™ Data Acquisition and Control Programming Tools (also includes the *Insta*Cal installation package, the *Universal Library User's Guide*, and the *Universal Library Function Reference*)

Cables

- C50FF-x



Signal termination and conditioning accessories

MCC provides signal termination and signal conditioning products for use with the PCI-INT32. Refer to the Field wiring, signal termination and conditioning section for a complete list of compatible accessory products.

Unpacking the board

The PCI-INT32 board is shipped in an antistatic container to prevent damage by an electrostatic discharge. To avoid such damage, perform the following procedure when unpacking and handling your board:

1. Before opening the antistatic container, ground yourself with a wrist-grounding strap or by holding onto a grounded object (such as the computer chassis).
2. Touch the antistatic container to the computer chassis before removing the board from the container.
3. Remove the board from the container. *Never* touch the exposed pins or circuit connections on the board.

If your PCI-INT32 is damaged, notify Measurement Computing Corporation immediately by phone, fax, or e-mail. For international customers, contact your local distributor where you purchased the PCI-INT32.

- Phone: 508-946-5100 and follow the instructions for reaching Tech Support.
- Fax: 508-946-9500 to the attention of Tech Support
- Email: techsupport@measurementcomputing.com

Installing the software

Install the software included with your board *before* you install the hardware. Installing the software first ensures that the information required for proper board detection is installed and available at boot up.

Refer to the *DAQ Software Quick Start* for instructions on installing the software on the *Measurement Computing Data Acquisition Software CD*. This booklet is shipped with the hardware, and is also available in PDF at www.mccdaq.com/PDFmanuals/DAQ-Software-Quick-Start.pdf.

Installing the hardware

The PCI-INT32 board is completely plug-and-play, with no switches or jumpers to set. Configuration is controlled by your system's BIOS. To install your board, follow the steps below.

Install the MCC DAQ software before you install your board

The driver needed to run your board is installed with the MCC DAQ software. Therefore, you need to install the MCC DAQ software before you install your board. Refer to the *DAQ Software Quick Start* for instructions on installing the software.

1. Turn your computer off, open it up, and insert your board into an available PCI slot.
2. Close your computer and turn it on.

   If you are using an operating system with support for plug-and-play (such as Windows 2000 or Windows XP), a dialog box pops up as the system loads indicating that new hardware has been detected. If the information file for this board is not already loaded onto your PC, you will be prompted for the disk containing this file. The MCC DAQ software contains this file. If required, insert the *Measurement Computing Data Acquisition Software* CD and click **OK**.
3. To test your installation and configure your board, run the *Insta*Cal utility installed in the previous section. Refer to the *DAQ Software Quick Start* that came with your board for information on how to initially set up and load *Insta*Cal.

Connecting the board for I/O operations

Connectors, cables – main I/O connector

Table 2-1 lists the board connectors, applicable cables and compatible accessory boards.

Table 2-1. Board connectors, cables, accessory equipment

Connector type	50-pin, high-density IDC header connector
Compatible cables	C50FF-*x* (Figure 2-1)
Compatible accessory products	CIO-MINI50

The PCI-INT32 I/O connector is a 50-pin header type connector accessible from the rear of the PC through the expansion backplate. The signals available are direct connections to the Z8536 digital I/O chips.

Signal name	Pin		Pin	Signal name	
GND	50		49	+5V	
C3 OUT C0	48		47	C1 C3 IN	
C3 TRIG C2	46		45	C3 C3 GATE	
INT INPUT	44		43	INT ENABLE	
NC	42		41	NC	
C2 OUT B0	40		39	B1 C2 IN	**First Z8536**
C2 TRIG B2	38		37	B3 C2 GATE	
C1 OUT B4	36		35	B5 C1 IN	**BADR + 0, 1, 2**
C1 TRIG B6	34		33	B7 C1 GATE	
A0	32		31	A1	
A2	30		29	A3	
A4	28		27	A5	
A6	26		25	A7	
C3 OUT C0	24		23	C1 C3 IN	
C3 TRIG C2	22		21	C3 C3 GATE	
2.5 MHz OUT	20		19	5 MHz	
INTA OUT	18		17	INTB OUT	**Second Z8536**
C2 OUT B0	16		15	B1 C2 IN	
C2 TRIG B2	14		13	B3 C2 GATE	**BADR + 4, 5, 6**
C1 OUT B4	12		11	B5 C1 IN	
C1 TRIG B6	10		9	B7 C1 GATE	
A0	8		7	A1	
A2	6		5	A3	
A4	4		3	A5	
A6	2		1	A7	

Figure 2-2. PCI-INT32 board I/O connector

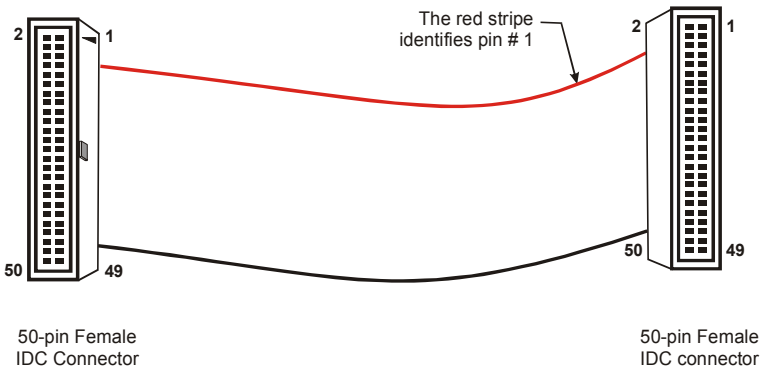


Figure 2-1. C50FF-x cable

Field wiring and signal termination accessories

You can use the following screw terminal boards to terminate field signals and route them into the PCI-INT32 using the C50FF-*x* cable.

- CIO-MINI50 – 50-pin screw terminal board. Details on this product are available on our web site at www.mccdaq.com/cbicatalog/cbiproduct.asp?dept_id=102&pf_id=258.

For additional information about digital interfacing…

Detailed information regarding digital interfacing is contained in MCC's *Guide to Signal Connections*. This document is available on our web site at www.measurementcomputing.com/signals/signals.pdf.

Programming and Developing Applications

After following the installation instructions in Chapter 2, your board should now be installed and ready for use.

Programming languages

Measurement Computing's Universal Library™ provides access to board functions from a variety of Windows programming languages. If you are planning to write programs, or would like to run the example programs for Visual Basic® or any other language, please refer to the *Universal Library User's Guide* (available on our web site at www.mccdaq.com/PDFmanuals/sm-ul-user-guide.pdf).

Packaged applications programs

Many packaged application programs, such as SoftWIRE®, Labtech Notebook™, and HP-VEE™, now have drivers for your board. If the package you own does not have drivers for your board, please fax or e-mail the package name and the revision number from the install disks. We will research the package for you and advise how to obtain drivers.

Some application drivers are included with the Universal Library package, but not with the application package. If you have purchased an application package directly from the software vendor, you may need to purchase our Universal Library and drivers. Please contact us by phone, fax or e-mail:

- Phone: 508-946-5100 and follow the instructions for reaching Tech Support.
- Fax: 508-946-9500 to the attention of Tech Support
- Email: techsupport@measurementcomputing.com

Register-level programming

You should use the Universal Library or one of the packaged application programs mentioned above to control your board. Only experienced programmers should try register-level programming.

If you need to program at the register level in your application, refer to the *Register Map for the PCI-INT32*. This document is available on our web site at www.mccdaq.com/registermaps/RegMapPCI-INT32.pdf.

Functional Details

DIO signals

All digital outputs and inputs on the PCI-INT32 connector are TTL (Transistor-Transistor-Logic). TTL is an electronics industry term which describes a standard for digital signals which are either at 0 V or 5 V (nominal).

Under normal operating conditions, the voltages on the Z8536 pins range from near 0 volts for the low state to near 5.0 volts for the high state. The current handling capability of these inputs / outputs is limited to a few milliamps. This is typical of TTL devices.

Caution! The voltages and currents associated with external devices range from less than a hundred mA at a few volts for a small flash light bulb to 50 Amps at 220 volts for a large electric range. Attempting to connect either of these devices directly to the PCI-INT32 would destroy the I/O chip.

For general information regarding digital I/O techniques, including signal conditioning and low pass filters, refer to the *Guide to Signal Connections*. This document is available on our web site at www.mccdaq.com/signals/signals.pdf).

IMPORTANT

The Z8536 digital I/O chip initializes all ports as inputs on power up and reset. A TTL input is a high impedance input. If you connect another TTL input device to the Z8536 it will probably be turned ON every time the Z8536 is reset, or, it might be turned OFF instead. Remember, and Z8536 which is reset is in INPUT mode.

It cannot be stated often enough to those unfamiliar with the Z8536 — whenever the Z8536 is powered on or reset, all pins are set to high impedance input.

Output devices such as solid state relays may be switched *on* whenever the computer is powered-on or reset. To prevent unwanted switching and to drive all outputs to a known state after power-on or reset, pull pins either high or low with a pull-up or pull-down resistor.

Pull-up/down resistors

When the Z8536 digital I/O chip is powered-on or reset, the control register is set to a known state. When used as an output device to control other TTL input devices, the Z8536 applies a voltage level of 0 V for low and 2.5 V to 5 V for high. The device being controlled responds to the output voltage level of the Z8536 chip.

The concept of voltage level of a Z8536 chip in input mode is meaningless. Do not connect a volt meter to the floating input of a Z8536. It will show you nothing of meaning. In input mode, the Z8536 is in 'high Z' or high impedance. If your Z8536 was connected to another input chip (the device you are controlling), the inputs of that chip are left floating whenever the Z8536 is in the input mode. If the inputs of the device you are controlling are allowed to float, they may float up or down. The direction they float is dependent on the characteristics of the circuit and is unpredictable. This is why it often appears that the Z8536 has gone 'high' after power up. The result is that the controlled device gets turned on. That is why you need pull up/down resistors.

Figure 4-1 shows a Z8536 digital output with a pull-up resistor attached.

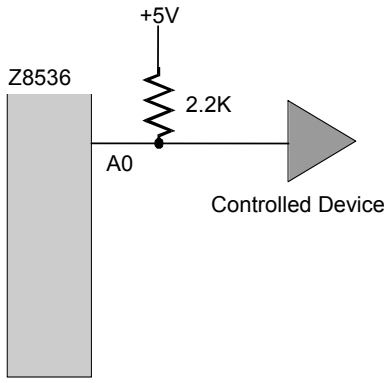


Figure 4-1. Z8536 digital output with pull-up resistor

The pull-up resistor provides a reference to +5V, while its value of 2,200 Ω allows only a little current to flow through the circuit.

If the Z8536 is reset and enters high impedance input, the line is pulled high. At that point, both the Z8536 AND the device being controlled will sense a high signal. If the Z8536 is in output mode, the Z8536 has more than enough power to override the pull-up resistor's high signal and drive the line to 0 volts (nominal).

With a pull-down resistor installed, the line is pulled low when the Z8536 is reset. The Z8536 has more than enough power to drive the line high.

To safeguard against unwanted signal levels, all devices that are controlled by the Z8536 chip should be tied low or high as required by a 2.2K Ω resistor. Open positions are located on the board to install resistor Single Inline Packages (SIP). The positions are marked A, B, and C and are adjacent to the Z8536.

The SIP is made up of eight 2.2 K resistors. One side of each resistor is connected to a single common point and brought out to a pin. The common line is marked with a dot or line at one end of the SIP. The remaining resistor ends are brought out to the other eight pins (refer to Figure 4-2).

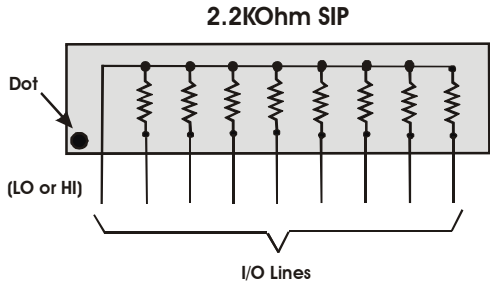


Figure 4-2. Eight-resistor SIP schematic

Figure 4-3 shows a schematic of an SIP installed in both the pull-up and pull-down positions.

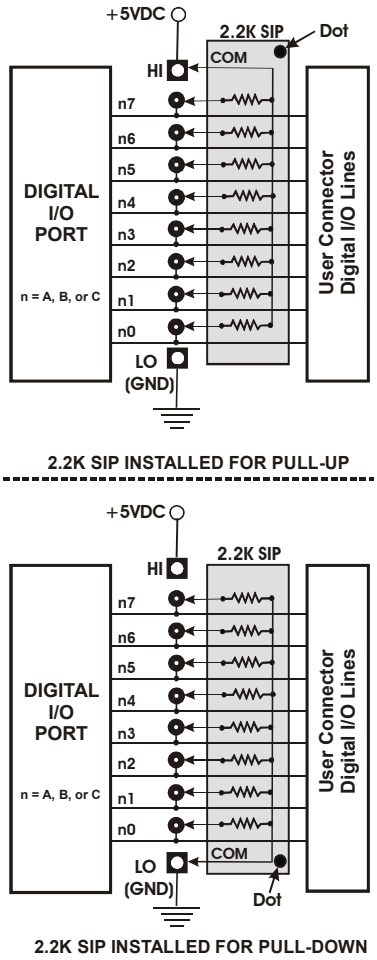


Figure 4-3. Pull-up and pull-down resistor SIP schematic

When installed, the SIP establishes either a high or low logic level at each of the eight I/O lines on the port. At each board location, A, B, and C, there are 10 holes in a line. The hole on one end is marked "HI" and is connected to +5V. The other end is marked "LO" and is connected to GND. The eight holes in the middle connect to eight lines of the port, A, B or C.

To pull-up lines, orient the SIP with the common pin (dot) toward the HI end; to pull-down, install the resistor with the common pin in the LO hole.

Note:
We recommend using 2.2K SIPs (MCC part number SP-K2.29C). Use a different value only if necessary.

Specifications

Typical for 25 °C unless otherwise specified.

Specifications in *italic text* are guaranteed by design.

Power consumption

Table 5-1. Power consumption specifications

+5V operating	620 mA typical, 925 mA max

Counter/timer and parallel I/O

Table 5-2. Counter/timer and parallel I/O specifications

Device	Zilog Z85C36 (2)
Output high	2.4 volts minimum @ -250 uA
Output low	0.5 volts maximum @ +3.2 mA
Input high	2.0 volts minimum, 7 volts absolute max
Input low	0.8 volts maximum, -0.3 volts absolute min
Power-up / reset state	Input mode (high impedance)
Configured as digital input/output ports:	
Digital configuration	4 banks of 8 (Ports A and B), 2 banks of 4 (Port C), programmable by bit or bank as input or output
Number of channels	40 I/O
Configured as counter/timers: (Port A is a digital I/O port only)	
Counter type	Zilog Z85C36
Counter configuration	6 16-bit counter/timers (Port B - High and Low nibble - and Port C) All Trigger (C1-C3 TRIG), Source (C1-C3 IN), Gate (C1-C3 GATE), and Output (C1-C3 OUT) for each chip are available at the user connector.
Clock input frequency	3 MHz max
High pulse width (clock input)	150 ns min
Low pulse width (clock input)	150 ns min
Trigger pulse width (high, low)	130 ns min

Interrupts

The Z8536 is programmable to generate interrupts based on bit change, pattern recognition, level or edge triggered, whether configured as a digital I/O port or counter port. Refer to the ZILOG *Z8036/Z8536 Product Specification* for further options.

Table 5-3. Interrupt specifications

Interrupts	INTA# - mapped to IRQn via PCI BIOS at boot-time
Interrupt enable	Programmable (enabled by default) and external (INT ENABLE), active low (pulled high through resistor).
Interrupt sources	Programmable: 8536A interrupt output, 8536B interrupt output, 8536A OR'ed with 8536B, external (INT INPUT, active low) or None.
Interrupt output	Buffered output for each chip available at user connector (INTA OUT, INTB OUT).
Interrupt priority	Programmable: No priority or 8536A interrupt has priority over 8536B interrupt.

Environmental

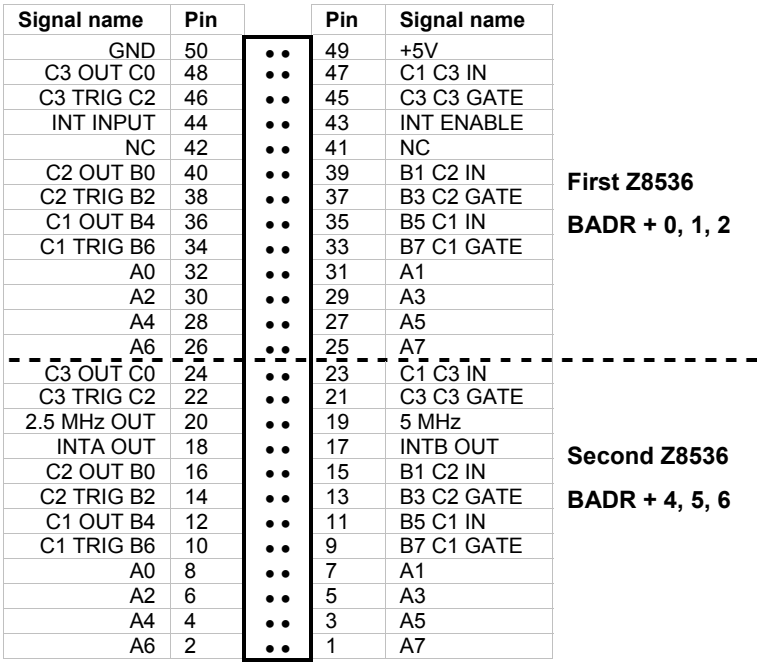
Table 5-4. Environmental specifications

Operating temperature range	0 to 50 °C
Storage temperature range	-20 to 70°C
Humidity	0 to 90% non-condensing

Main connector and pin out

Table 5-5. Board connectors, cables, accessory equipment

Connector type	50-pin, high-density IDC header connector
Compatible cables	C50FF-x
Compatible accessory products	CIO-MINI50



Signal name	Pin		Pin	Signal name	
GND	50	••	49	+5V	
C3 OUT C0	48	••	47	C1 C3 IN	
C3 TRIG C2	46	••	45	C3 C3 GATE	
INT INPUT	44	••	43	INT ENABLE	
NC	42	••	41	NC	
C2 OUT B0	40	••	39	B1 C2 IN	**First Z8536**
C2 TRIG B2	38	••	37	B3 C2 GATE	
C1 OUT B4	36	••	35	B5 C1 IN	**BADR + 0, 1, 2**
C1 TRIG B6	34	••	33	B7 C1 GATE	
A0	32	••	31	A1	
A2	30	••	29	A3	
A4	28	••	27	A5	
A6	26	••	25	A7	
C3 OUT C0	24	••	23	C1 C3 IN	
C3 TRIG C2	22	••	21	C3 C3 GATE	
2.5 MHz OUT	20	••	19	5 MHz	
INTA OUT	18	••	17	INTB OUT	**Second Z8536**
C2 OUT B0	16	••	15	B1 C2 IN	
C2 TRIG B2	14	••	13	B3 C2 GATE	**BADR + 4, 5, 6**
C1 OUT B4	12	••	11	B5 C1 IN	
C1 TRIG B6	10	••	9	B7 C1 GATE	
A0	8	••	7	A1	
A2	6	••	5	A3	
A4	4	••	3	A5	
A6	2	••	1	A7	

EC Declaration of Conformity

We, Measurement Computing Corporation, declare under sole responsibility that the product:

PCI-INT32	Interrupt vector board
Part Number	*Description*

to which this declaration relates, meets the essential requirements, is in conformity with, and CE marking has been applied according to the relevant EC Directives listed below using the relevant section of the following EC standards and other normative documents:

- EU EMC Directive 89/336/EEC: Essential requirements relating to electromagnetic compatibility.
- EN 55022 Class B (1995): Radiated and conducted emission requirements for information technology equipment.
- EN 50082-1 (1997): EC generic immunity requirements.
- EN 61000-4-2 (1995): Electrostatic discharge immunity.
- EN 61000-4-3 (1997) ENV 50204 (1996): RF immunity.
- EN 61000-4-4 (1995): Electric fast transient burst immunity.

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